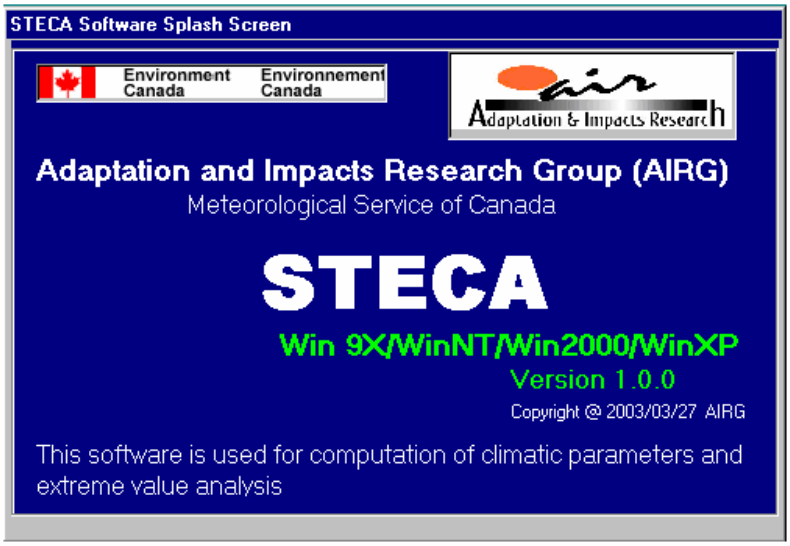
Environment Canada Environnement Canada

Statistical Tool for Extreme Climate Analysis (STECA)© User Manual


STECA Software Splash Screen
Environment Canada
Environnement Canada
Adaptation & Impacts Research
Adaptation and Impacts Research Group (AIRG)
Meteorological Service of Canada
STECA
Win 9X/WinNT/Win2000/WinXP
Version 1.0.0
Copyright @ 2003/03/27 AIRG
This software is used for computation of climatic parameters and extreme value analysis

Adaptation and Impacts Research Group (AIRG)
Meteorological Service of Canada

STECA© User Manual

1. SETUP OR INSTALLATION OF THE SOFTWARE

a. Double click the setup.exe file. STECA Setup screen showing “Welcome to the STECA installation program” (Figure 1) message appears.

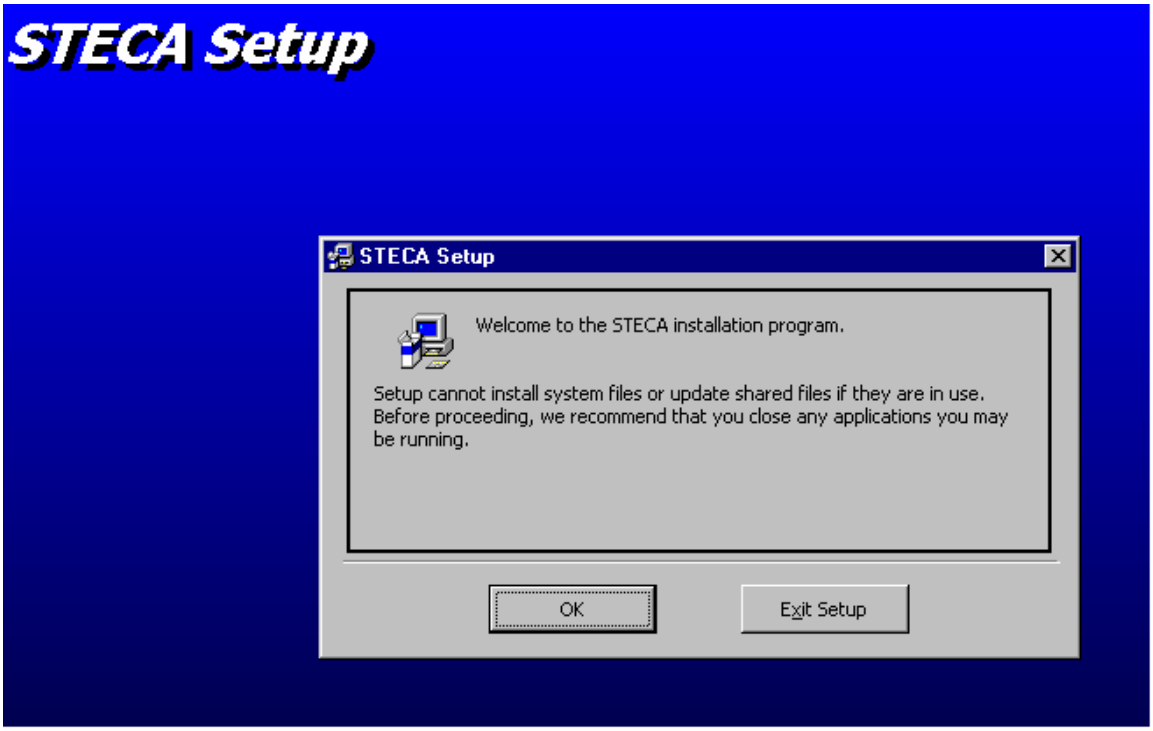

STECA Setup
STECA Setup
Welcome to the STECA installation program.
Setup cannot install system files or update shared files if they are in use. Before proceeding, we recommend that you close any applications you may be running.
OK
Exit Setup

Figure 1. Setup Screen 1

b. Click the **OK** button. *Figure 2* shows up.

c. Click the **Change Directory** button.

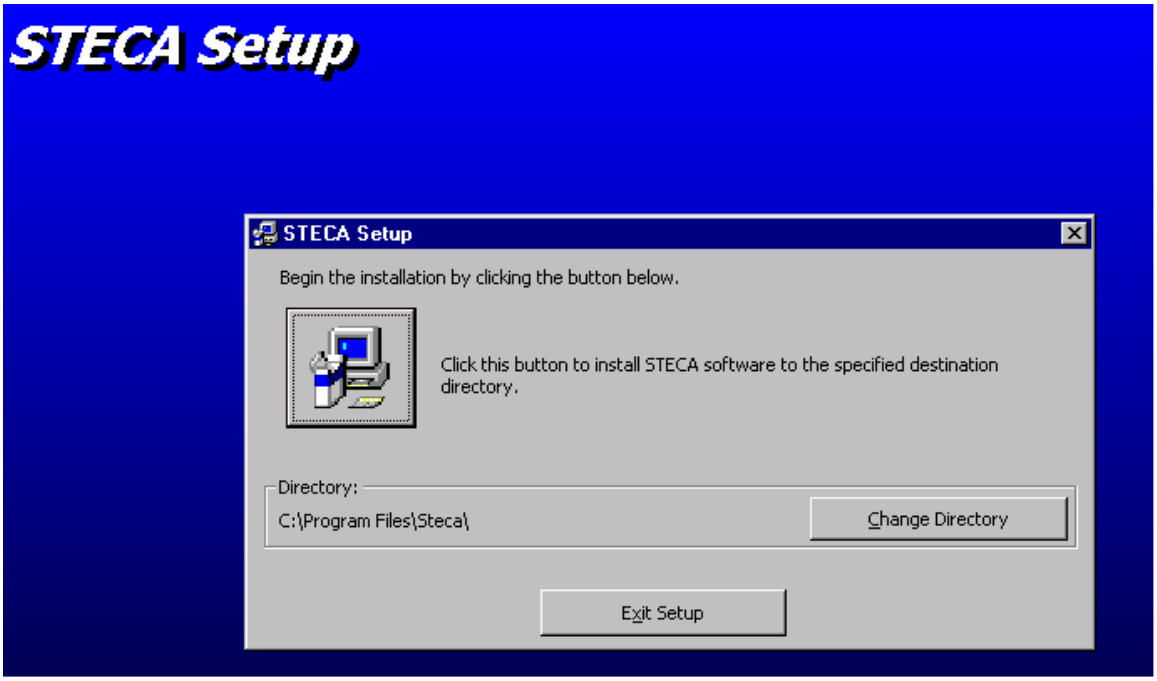


Figure 2. Setup Screen 2

d. The screen shown in Figure 3 will appear. Chose the desired drive where the software is to be installed. In the path: box, type STECA after the drive name, as shown in Figure 3. Then click the **OK** button. Figure 4 appears. Follow the screen instructions.

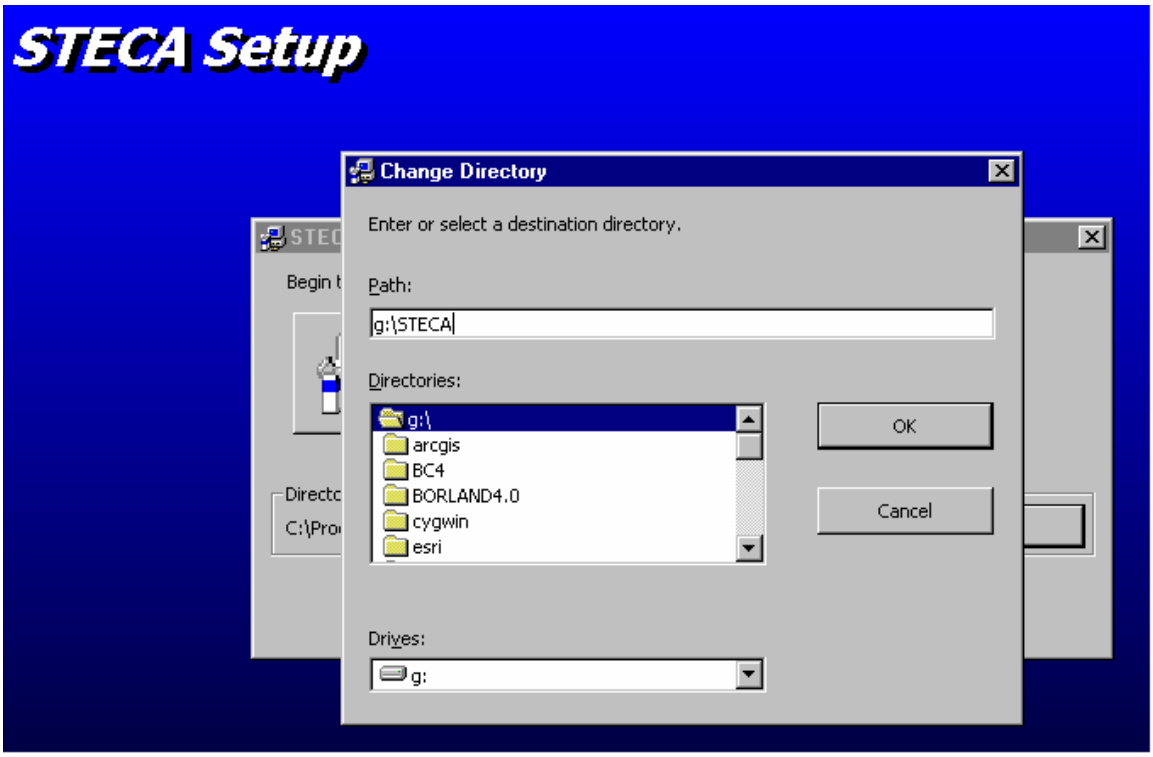


Figure 3. Change Directory Screen

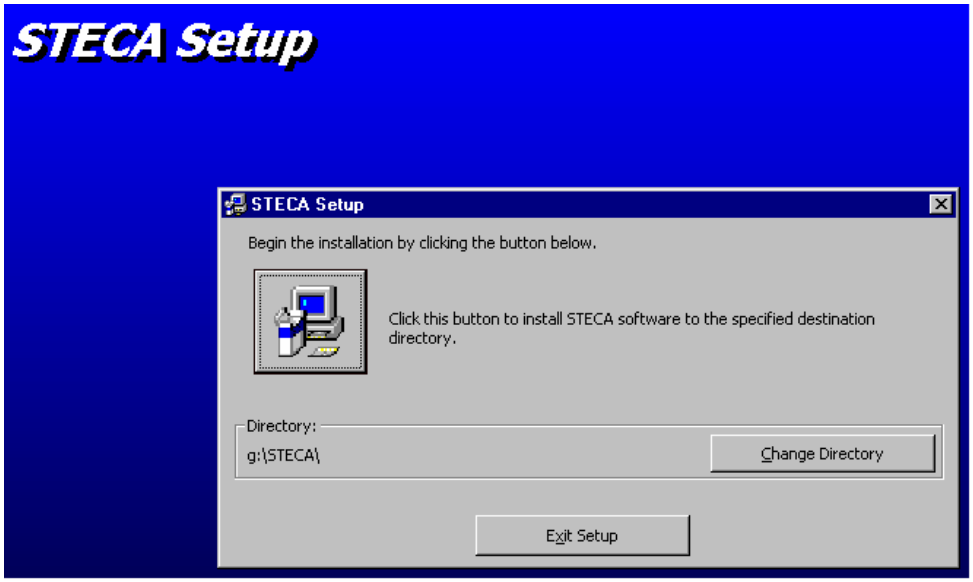


Figure 4. Setup Screen 4

e. Click the **Continue** button on the screen as shown in *Figure 5*. This will take a few minutes for the computer to copy the files and to install the STECA software into the specified drive.

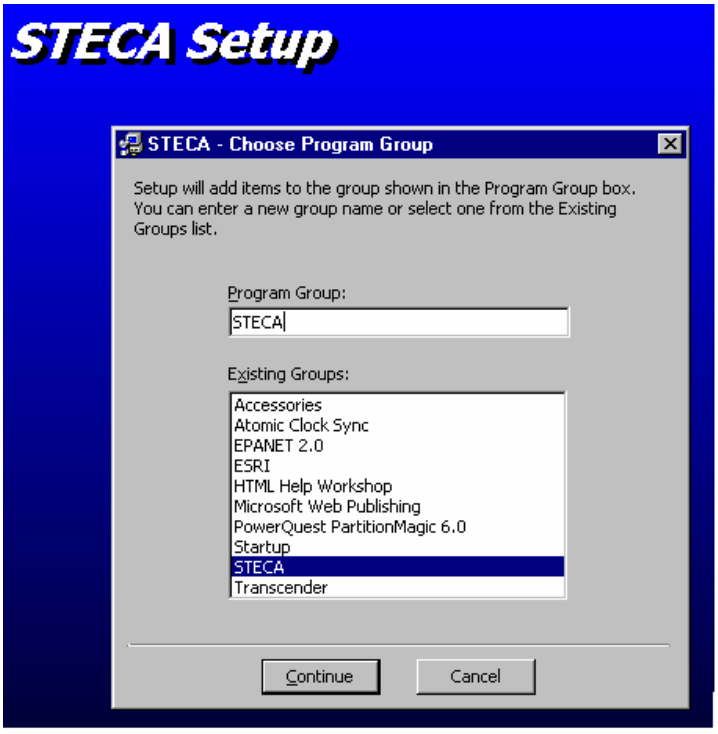


Figure 5. Setup Screen 5

f. After the completion of installation the user will get a message indicating so. Just click **OK** to finish.

g. To open the software for use, click the **Start** button at the lower left corner of the desktop. In the **Programs** menu, select the **STECA** submenu. Select the **Steca** icon in the submenu that appears. The option screen will then load.

2. DESCRIPTION OF THE SOFTWARE

This software has a very self-explanatory graphical user interface (GUI) for input of data and a step-by-step analysis. The screen that appears first is the **option screen**. Here the user must give a computation option. The next screen that comes up is based on what type of analysis and what station option one wishes to select. The analysis options are: **Degree Day, Basic Statistics, Data Preparation, Frequency Analysis, Atmospheric Climate Analysis, Heat Index, Wind Chill** and **Relative Humidity**. The station option has only two choices: **Single Station** and **Multiple Station**.

Any analysis begins with the selection of an input data file from the **File** menu. In the main menu, there is a **File** menu, which has an **Input File** sub menu. Once the input file is selected, further data analysis can be achieved. For the multiple station option, the input file is a file containing a list of selected stations. Here, there is an option for making the file list in the sub menu of the **File** menu.

For the **Degree Day** analysis, the user needs to select an average daily temperature file with the extension *.003. The drop-down menu of the **Degree Day** menu contains menus for **Heating Degree Day** and **Cooling Degree Day** computations. Clicking the appropriate sub menu completes the analysis giving a message about where the output file is saved.

The third menu is the **Data Preparation**, which has 4 drop-down sub menus that include **Extract Data Series, Basic Statistic Calculation:** used for extreme value series; **Daily Data Basic Statistics:** used for basic statistic computations of the daily data; and **Data Validation. Extract Data Series** has 2 sub menus for the extraction of an annual maximum value (**Extreme High),** and an annual minimum value (**Extreme Low)**. **Data Validation** has 6 sub menus - **Randomness, Auto Correlation Test, Mann-Whitney Shift, Box Plot, Mann-Kendall Trend,**

and **Kruskal-Wallis Test**. For these tests the user needs to select an annual maximum or minimum series as an input file from the **File** menu.

For the **Frequency Analysis**, the user first needs to generate the **annual maximum** or **minimum series**. The annual maximum or minimum series can be generated by selecting any daily data series file as an input file. Following this, the user must proceed by switching to the **Data Preparation** main menu, then selecting the **Extract Data Series,** and finally selecting and clicking the **Extreme High** sub menu for the maximum, or **Extreme Low** sub menu for the minimum series. Once the series computation is complete, the program informs the user of the destination of the files computed by a message on the screen. Now the user needs to select that maximum or minimum series as an input file for the **Frequency Analysis**. For the **High Value Frequency Analysis,** one must select a maximum data series; while for a **Low Value Frequency Analysis,** one must select a minimum data series.

The **High Value Frequency Analysis** main menu has 4 sub menus which include: **Event of Specified Return Period, Return Period of Specified Event, Kolmogorov-Smirnov Test** and **Probability Plot Correlation Coefficient Test**. By selecting the **High Value Frequency Analysis** from the main menu, and choosing one of those sub menus mentioned above, it brings the user to an option form in a drop-down list box. This list box provides 3 options for frequency analysis methods - **Normal, Gumbel, and Pearson Type 3 Distributions**. Selecting any of the available option completes the analysis. The result of the analysis is written to the screen on the screen, and is also saved on a disk. A message box appears informing the user that the file has been saved.

The **Low Value Frequency Analysis** menu has two sub menus – **Left Unbounded** and **Left Bounded by Zero**. The **Left Unbounded** has the sub menus that are identical to the **High Value Frequency Analysis: Event of Specified Return Period, Return Period of Specified Event, Kolmogorov-Smirnov Test,** and **Probability Plot Correlation Coefficient Test**. By selecting any of the sub menus it brings the user to a form, from where one needs to select a frequency distribution method in a drop-down list box. As mentioned previously, 3 methods are available. Selecting any of the available options completes the analysis. The result of the analysis comes up on the screen, and is also saved on a disk. A message box appears informing the user that the file has been saved.

The **Left Bounded by Zero** sub menu has the same sub menus as that of the **Left Unbounded**, but with 3 additional distributions listed in the drop-down list box. These include **Weibull, Log-Normal**, and **Log-Pearson Type 3 Distributions.**

For **Wind Chill, Heat Index, Heat Wave** and **Relative Humidity Analysis,** one must select the appropriate option, and then click the **Proceed On** Button. From the **Atmospheric Climate** option, one must choose an appropriate selection. Depending on the selection made, a screen will then appear with the results.

The last menu is the **Help** menu, which explains each of the menus, sub menus, methods, procedures of analysis, data formats, and the sequences of analytical processes. The **Help** menu can be invoked anytime by pressing the **F1** key. Currently the **Help** menu items are still at the development stages.

3. LOADING THE DATA FILE

The input file is selected by choosing the **Input File** sub menu from the **File** menu. The **Input File Selection Screen** will then appear as shown in *Figure 6.*

4. CALCULATION PROCEDURE

Clicking on the **Start** button in the lower left hand corner of the desktop brings up a menu list. A menu list will then appear. Click on the **Programs** icon. From the **Programs** menu, select the **STECA** sub menu. Then proceed by clicking the **Steca** sub menu. The option screen will then appear. Make the selection of an analysis option and a station option that one wishes to use. For a single station option the following analyses can be conducted.

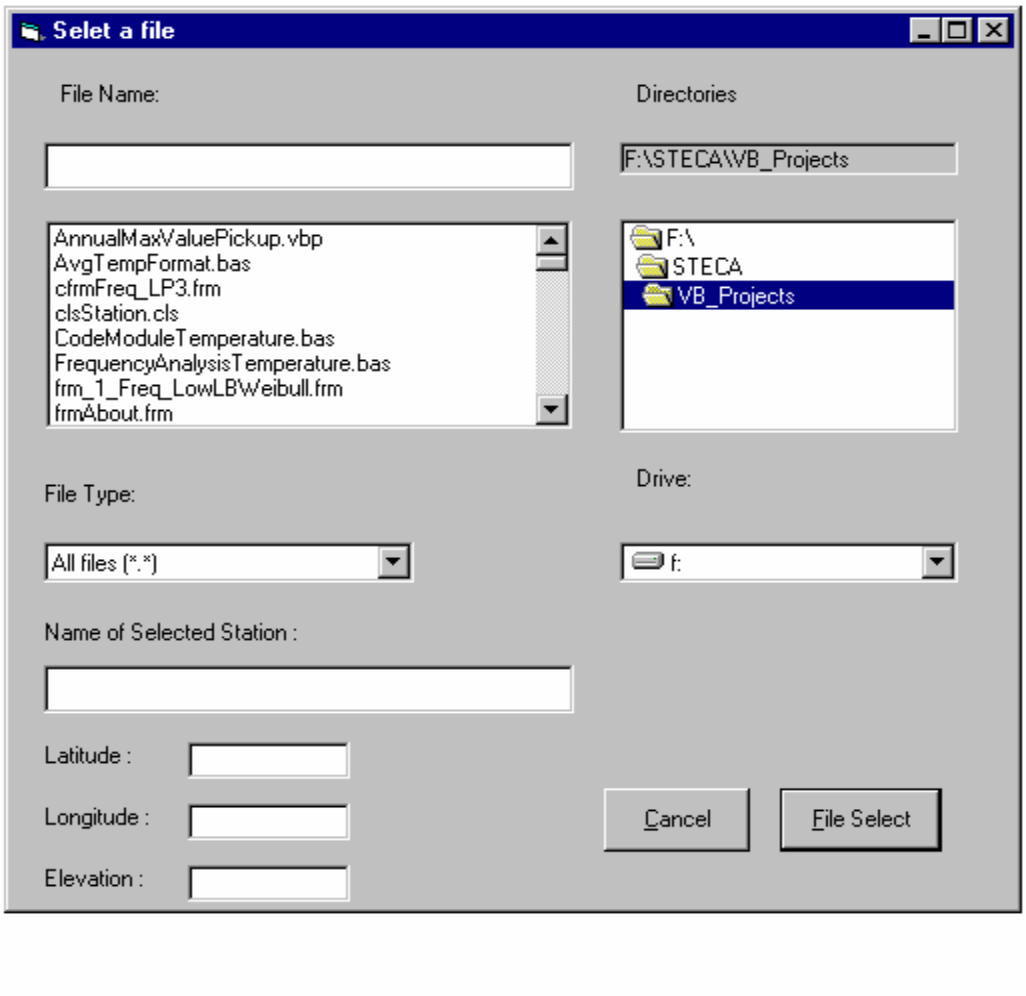


Figure 6. File Input Screen

Single Station Analysis:

Degree Day

The analysis begins with the selection of an input file. The input file is reached by selecting the **Input File** sub menu from the **File** menu. The **Input File Selection Screen** will then appear as previously shown in *Figure 6*. The **Daily Average Temperature File** with the extension **003** is to be selected. To load the data file, either double click on the file, or select and click the **File** button. A screen showing the name of the selected file will then appear. If the selected file is the correct one, press the **Yes** option to select it. Click the **OK** button to proceed with the computation.

Atmospheric Climate:

Heat Index

Begin with the selection of an input file. The input file is selected by choosing by selecting the **Input File** sub menu from the **File** menu. The **Input File Selection Screen** will then appear as previously shown in *Figure 6*. The **Hourly Atmospheric Temperature** (i.e., the dry bulb temperature) **File** with the extension **078** is to be selected. To load the file, either double click on the file, or select and click the **File** button. A screen showing the name of the selected file will then appear. If the selected file is the correct one, press the **Yes** option to select it. Click the **OK** button to proceed with the computation. The result of the analysis will then be printed on the screen, and a saved to a disk as text file. A message box appears to indicate the destination of the text file.

Heat Wave

Begin with the selection of an input file. The input file is selected by choosing the **Input File** sub menu from the **File** menu. The **Input File Selection Screen** will then appear as previously shown in *Figure 6*. The **Daily Maximum Temperature File** with the extension **001** is to be selected. To load the file, either double click on the file, or select and click the **File** button. A screen showing the name of the selected file will then appear. If the selected file is the correct one, press the **Yes** option to select it. Click the **OK** button to proceed with the computation. Now, one must go to the **Atmospheric Climate** menu. From the drop-down sub menu, select and click the **Heat Wave** sub menu. The result of the analysis will then be printed on the screen, and saved to a disk as a text file. A message box appears to indicate the destination of the text file.

Cold Wave

Begin with the selection of an input file. The input file is selected by choosing the **Input File** sub menu from the **File** menu. The **Input File Selection Screen** will then appear as previously shown in *Figure 6*. The **Daily Maximum Temperature File** with the extension **001** is to be selected. To load the file, either double click on the file, or select and click the **File** button. A screen showing the name of the selected file will then appear. If the selected file is correct, then the **Yes** option is to be selected. Click the **OK** button to proceed with the computation. Now, one must go to the **Atmospheric Climate** menu. From the drop-down sub menu, select and click the **Cold Wave** sub menu. The result of the analysis will then be printed on the screen, and

a text file will also be saved on a disk. A message box appears to indicate the destination of the text file.

Wind Chill

Begin with the selection of an input file. The input file is selected by choosing the **Input File** sub menu from the **File** menu. The **Input File Selection Screen** will then appear as previously shown in *Figure 6*. The **Hourly Atmospheric Temperature** (i.e., the dry bulb temperature) **File** with the extension **078** is to be selected. To load the file, either double click on the file, or select and click the **File** button. A screen showing the name of the selected file will then appear. If the selected file is correct, then the **Yes** option is to be selected. Click the **OK** button to proceed with the computation. The result of the analysis will then be printed on the screen, and a text file will also be saved on a disk. A message box appears to indicate the destination of the text file.

Relative Humidity

Clicking on this submenu will bring up a data input screen. Enter the input data in the appropriate text boxes and click the **Calculate RH** button. This action will bring up the results on the screen.

Extreme Value Analysis

The **Extreme Value Analysis** is done through the annual maximum or annual minimum data series. The extreme value series is extracted from the daily data file.

Extraction of Extreme High Value Series

From the **File** menu, select and click the **Input File** sub menu. From the **File Selection** select the appropriate daily data file. Proceed through the screen prompts. From the **Data Preparation** main menu, select the **Extract Data Series** sub menu. From this submenu select **Extreme High**. By clicking the **Extreme High** the annual maximum series will be extracted and will then be written to a disk as a text file. A message box appears to indicate the destination of the text file.

Extraction of Extreme Low Value Series

From the **File** menu, go to the **Select Input File** sub menu. Then from the selection screen, select the appropriate daily data file. Proceed through the screen prompts. From the **Data Preparation** main menu, select the **Extract Data Series** sub menu. From this submenu select the **Extreme**

Low. The annual minimum series will be extracted and will then be written to a disk in a text file. A message box appears to indicate the destination of the text file.

Data Validation

Since the **Frequency Analysis** is done with the annual maximum or minimum series, the data series must be validated first, and it must follow certain assumptions. The following statistical tests are performed for **Data Validation** of the annual maximum or minimum series.

Randomness

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu, select the **Data Validation** sub menu. From the drop-down sub menu, select and click the **Randomness** icon. The **Randomness** computation screen will then appear. Click on the **Test Randomness** button. The results of the **Randomness** test are written to the screen and to a disk in a text file "VldFrqOut."

Auto Correlation Test or Serial Correlation

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu, select the **Data Validation** sub menu. From the drop-down sub menu, select and click the **Auto Correlation**. The **Serial Correlation** computation screen appears. Click on the **Run** button. The results of the **Auto Correlation** test are written to the screen, and to a disk in a text file "VldFrqOut."

Mann-Whitney Shift

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu, select the **Data Validation** sub menu. From the drop-down sub menu, select **Mann-Whitney Shif**t. The **Mann-Whitney Shift** computation screen appears. Click on the **Run** button. The results of the **Mann-Whitney Shift** test are written to the screen and to a disk in a text file "VldFrqOut."

Box Plot

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu, select the **Data Validation** sub menu. From the drop-down sub menu,

select **Box Plot**. The **Box Plot** computation screen comes up. Click the **Run** button. The results of the **Box Plot** test are written to the screen and to a disk in a text file, "VldFrqOut."

Mann-Kendall Trend

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu, select the **Data Validation** sub menu. From the drop-down sub menu, select and click the **Mann-Kendall Trend** icon. The **Mann-Kendall Trend** computation screen appears. Click the **Run** button. The results of the **Mann-Kendall Trend** test are written to the screen and to a disk in a text file "VldFrqOut."

Kruskal-Wallis Test

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu, select the **Data Validation** sub menu. From the drop-down sub menu, select the **Kruskal-Wallis** icon. The **Kruskal-Wallis Test** computation screen comes up. Click the **Run** button. The results of the **Kruskal-Wallis Test** are written to the screen and to a disk in a text "VldFrqOut."

Basic Statistics Computation

Basic Statistics Computations are done for the daily data series and the annual maximum or minimum series.

Annual Extreme Value Basic Statistics

Select an annual maximum or minimum series data file as an input file. From the **Data Preparation** main menu select the **Annual Extreme Value Basic Statistics** sub menu. The **Basic Statistics** computation screen appears. Click on the **Calculate Basic Statistics** button. The results of the **Basic Statistics** computations are written to the screen and to a disk in a text file "VldFrqOut."

Daily Data Basic Statistics

Select a daily data series file as an input file. From the **Data Preparation** main menu select the **Daily Data Basic Statistic** sub menu and then select and click the **Calculate Dly Data Basic Stat** sub menu. The **Basic Statistics of Daily Data** computation screen comes up. Click on the

Calculate Basic Statistic button. The results of the **Basic Statistics** computation are printed to the screen and to a text file provided by the user.

Student's t-Test

From the **Data Preparation** main menu, select the **Daily Data Basic Statistic** sub menu, and then select and click the **Student's t-Test** sub menu. The **Student's t-Test** screen appears. Enter the input data in the text boxes provided, and then click the **Perform Student's t-Test** button. The result of computation will then be printed to the screen.

Percentile

From the **Data Preparation** main menu select the **Percentiles** sub menu. The **Percentiles** of the daily data screen appears. Click the **Calculate Percentiles** button. An **Input Box** pops up. Enter the desired season and click **OK**. Another **Input Box** pops up. Enter the desired percentile value in decimal form (e.g., 0.85 for 85%) and click **OK**. The result of computation will then be printed to the screen.

Extreme High Value Frequency Analysis

From the **File** menu, select and click the **Input File** sub menu. From the **Input File Selection Screen** select an annual maximum series file extracted earlier. The file name must end with 'Max' before the period (.). For example, 1012040Max.001 is the annual maximum series of the daily maximum temperature. From the **High Value FreqAnalysis** main menu select the appropriate sub menu. This sub menu presents 4 choices: **Kolmogorov-Smirnov Test, Probability Plot Correlation Test, Event of Specified Return Period,** and **Return Period of Specified Event.** Clicking on any of these choices, it will bring the user to the next screen. On this screen, the user will need to choose a method of **Frequency Distribution Analysis** that is available from the drop-down list box. Choosing any of the methods and clicking on the **Proceed On** button will calculate the results and print them to the screen.

Extreme Low Value Frequency Analysis

The same methodology used for applies to the high value frequency applies to the **Low Value Frequency Analysis.** The only difference is that from the main menu selecting **Low Value Frequency Analysis** presents two submenu choices, **Left Unbounded** and **Left Bounded by Zero.** Both of these sub menus present four more sub menu choices: **Kolmogorov-Smirnov**

Test, Probability Plot Correlation Test, Event of Specified Return Period, and **Return Period of Specified Event.** The input file will be an annual minimum series marked by 'Min' at the end of the file name, e.g. 1012040Min.001.

Multiple Station Analysis

For the **Multiple Station** option, the input file is a file containing a list of selected stations. There is an option for selecting the file list in the appropriate submenu of the **File** menu.

Select Input File List

When multiple station option is selected the multiple station analysis main menu appears. From File menu select the **Select Input File List** submenu, and the File Input screen appears. Open the appropriate folder and select the desired file type in the file type list box. Select the desired files. To select multiple files hold down the Ctrl key while clicking on them. Once the selection is completed, click the **Select File** button. A screen for entering the name of the list comes up. Type in an appropriate name and follow the on-screen instructions.

Select Input File

Once the list is completed, select it as an input file from the appropriate submenu of the **File** menu. Proceed with the desired analysis as before.

5. SAVING THE OUTPUT

The output of the analysis is printed to the screen and written to a text file as well. A message appears to indicate the destination of the text file.